

**TITLE OF THE INVENTION****COMPOUND SOUND GENERATOR****BACKGROUND OF THE INVENTION**

5       The present invention relates to a compound sound generator for an information equipment such as a portable telephone.

The compound sound generator has a speaker for converting a call signal into a sound and a receiver for  
10      converting a sound signal into a sound. The sound emitted from the receiver is heard with user's ear close to the telephone and the sound emitted from the speaker is heard even when the telephone is away. Thus the speaker generates sounds of larger volume than the receiver.

15      Fig. 2 is a sectional view of a conventional compound sound generator set in a case 20 of an information equipment.

The compound sound generator has a flat circular or ellipse shape and is set in a case 20 having substantially a shape of a box. In the case 20, there is provided an annular  
20      frame 1 made of synthetic resin on which are various parts of the sound generator mounted, and a common yoke 2 made of a magnetic material is mounted in the frame 1.

The yoke 2 comprises a flange 2a formed on an upper periphery of a cylindrical portion 2b having a bottom 2c.  
25      An annular first magnet 3 for the speaker is secured to the underside of the flange 2a, and a second magnet 8 for the receiver having disc shape is secured to the bottom 2c of the yoke 2. An annular first top plate 4 made of a magnetic

material is secured to the underside of the first magnet 3, and a second top plate 9 having a disc shape is secured to the upper surface of the second magnet 8.

A first diaphragm 6 is secured to the underside of the frame 1, thereby forming a relatively small back chamber 22a between the diaphragm 6 and the yoke 2. A second diaphragm 11 is secured to the upper surface of the frame 1, thereby forming a relatively small back chamber 22b between the diaphragm 11 and the yoke 2. A first voice coil 5 and a second voice coil 10 are secured to inside surfaces of the first and second diaphragms 6 and 11, respectively. The first diaphragm 6 and the first voice coil 5 compose a first sound production device as a speaker, and the second diaphragm 11 and the second voice coil 10 compose a second sound production device as a receiver. Protectors 7 and 12 each having a dish shape and made of a thin metal plate are secured to the underside and upper surface of the frame 1 for protecting the diaphragms 6 and 11.

There is formed sound discharge holes 7a formed in the protector 7, sound discharge holes 12a in the protector 12.

The outer peripheries of the protector 7 and the diaphragm 6 are inserted and press fitted in an annular recess formed in a lower projection 1a of the frame 1. The outer peripheries of the protector 12 and the diaphragm 11 are inserted and press fitted in an annular recess formed in an upper projection 1b of the frame 1.

The compound sound generator is assembled into the case with other parts. Cushioned annular spacers 21 are

disposed between each of the protectors 7 and 12 at outer portions of the sound discharge holes 7a and 12a and the inner space of the case 20.

The case 20 has a plurality of sound discharge holes 5 20a formed in the bottom thereof and a sound discharge hole 20b formed in the upper surface thereof.

Sound produced by the diaphragm 11 is discharged through the sound discharge holes 12a and further outside through the sound discharge hole 20b as shown by an arrow 10 a. Similarly, sound produced by the diaphragm 6 is discharged through the sound discharge holes 7a and further outside through the sound discharge holes 20a as shown by an arrow b. Mixing of sounds emitted from the back chambers 22a and 22b with the sounds emitted through the sound 15 discharge holes 7a and 12a are prevented. The spacers 21 are provided to enhance the air-tightness, thereby separating the sounds from one another.

In order to allow the vibration of the diaphragms and to improve the acoustic characteristics such as volume and 20 sound quality, the back chambers 22a and 22b are communicated with atmosphere. Namely, as shown by arrows c and d, air in the back chamber 22b flows through openings 1d partially formed in the projection 1b into the inner space of the case 20. Air in the back chamber 22a flows into the inner space 25 of the case 20 through air passages 1c formed in the shoulder of the frame 1 as shown by arrows e and f.

In the conventional compound sound generator, the back chambers 22a and 22b are thus communicated with the entire

inner space of the case 20. Therefore, a part of the airflow from one of the back chambers 22b and 22a may flow into the other back chamber through the openings 1d or the passages 1c as shown by arrows g and h. Hence, when the diaphragm 5 6 for the speaker is vibrated, the produced sound causes the air pressure to change, thereby vibrating the diaphragm 11 for the receiver so that sound is also emitted from the receiver. If a large sound is emitted from the receiver with user's ear close to the telephone, the user's ear may be hurt. In 10 another case, telephone conversation may leak out and be heard by others through the receiver.

#### SUMMARY OF THE INVENTION

An object of the present invention is to provide a 15 compound sound generator which prevents sound leaking and causing vibration of the other diaphragm.

According to the present invention, there is provided a sound generator for an information equipment comprising a case of the equipment, a frame set in the case, a speaker 20 and receiver provided in the frame, the speaker having a first diaphragm and the receiver having a second diaphragm, a first back chamber behind the first diaphragm of the speaker and a second back chamber behind the second diaphragm of the receiver, and a baffle formed integrally with the frame so 25 as to separate the first and second back chambers from each other.

The baffle is provided to surround an outside of the second diaphragm of the receiver, and to form an annular space

to communicate with the second back chamber of the receiver.

The first back chamber of the speaker is opened to a space between the outside wall of the baffle and the inside wall of the case.

5 At least one of the first back chamber of the speaker and the second back chamber of the receiver is opened to the outside of the case at a position different from other openings.

These and other objects and features of the present  
10 invention will become more apparent from the following detailed description with reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF DRAWINGS

15 Fig. 1 is a sectional side view showing a compound sound generator of the present invention, set in a case of a portable telephone; and

Fig. 2 is a sectional side view showing a conventional compound sound generator set in a case of a portable telephone.

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#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 is a sectional view of a compound sound generator of a first embodiment according to the present invention, set in a case of a portable telephone.

25 The compound sound generator of the present invention is set in an ellipse shaped case 50. In the case 50, there is provided a frame 31 made of synthetic resin, on which various parts of the sound generator are mounted, and a common yoke

32 made of a magnetic material is mounted in the frame 31.

The yoke 32 comprises a flange 32a formed on an upper periphery of a cylindrical portion 32b having a bottom 32c. An annular first magnet 33 is secured to the underside of  
5 the flange 32a with an adhesive, and a second magnet 38 having disc shape is secured to the bottom 32c of the yoke 32. An annular first top plate 34 made of a magnetic material is secured to the underside of the first magnet 33, and a second top plate 39 having a disc shape is secured to the upper surface  
10 of the second magnet 38.

A first diaphragm 36 is secured to the underside of the frame 31, thereby to form a back chamber 43a between the diaphragm 36 and the yoke 32. A second diaphragm 41 is secured to the upper surface of the frame 31, thereby to form a back  
15 chamber 43b between the diaphragm 41 and the yoke 32. The first diaphragm has a larger size approximate to the protector 37, and the second diaphragm has a smaller size approximate to the protector 42. A first voice coil 35 and a second voice coil 40 are secured to inside surfaces of the first and second  
20 diaphragms 36 and 41, respectively. The first diaphragm 36 and the first voice coil 35 compose a first sound production device as a speaker, and the second diaphragm 41 and the second voice coil 40 compose a second sound production device as a receiver. First and second protectors 37 and 42, each having  
25 a dish shape and made of a thin metal plate, are secured to the underside and upper surface of the frame 31 for protecting the diaphragms 36 and 41.

The first protector 37 has a sound discharge hole 37a

so as to discharge sounds produced by the first diaphragm 36 in the downward direction. The second protector 42 has sound discharge holes 42a so as to discharge sounds produced by the second diaphragm 41 in the upward direction.

5       The frame 31 has a lower projection 31a and an upper projection 31b. In the lower projection 31a, an annular recess is formed so that the outer peripheries of the protector 37 and the diaphragm 36 are inserted and press fitted therein. In the upper projection 31b, an annular recess is formed so  
10      that the outer peripheries of the protector 42 and the diaphragm 41 are inserted and press fitted therein. In a shoulder 31c of the frame 31, an air passage 31d is formed. A pair of opening 31e are formed in the lower portion of the upper projection 31b.

15      In accordance with the present invention, the frame 31 further has an upward extending annular baffle 31f at the outer side of the upper projection 31a, so as to surround the diaphragm 41.

The compound sound generator is assembled into the case  
20      50 with other parts. Annular spacers 51 are disposed between each of the protectors 37, 42 and the inner surface of the case 50. An annular spacer 54 is interposed between the upper end of the baffle 31f and the inner surface of the case 50.

The case 50 has a plurality of sound discharge holes  
25      50a formed in the bottom thereof at a portion inside the spacers 51 and a sound discharge hole 50b formed in the upper surface thereof.

Sounds produced by the diaphragm 41 are discharged

through the sound discharge holes 42a of the protector 42 and further outside of the case 50 through the sound discharge hole 50b as shown by the arrow a. Similarly, sounds produced by the diaphragm 36 are discharged through the sound discharge 5 holes 37a of the protector 37 and further outside the case through sound discharge holes 50a as shown by the arrow b.

As shown by the arrow c, air in the back chamber 43b flows through the openings 31e formed in the projection 31b into an annular space defined by the baffle 31f, projection 10 31b and spacers 51 and 54. Therefore, it can be said that, by adding the volume of the annular space, the volume of the back chamber 43b is virtually increased. Since the outer circumference of the baffle 31f can be substantially the same as that of the first diaphragm 36 in maximum, and the outer 15 circumference of the second diaphragm 41 is smaller than that of the first diaphragm 36, the annular space between the baffle 31f and the outer periphery of the diaphragm 41 has a large volume. Thus the rear resistance of the vibration of the diaphragm 41 and hence the acoustic impedance are reduced 20 so that the acoustic characteristics are improved.

Air in the back chamber 43a flows into the inner space of the case 50 through air passages 31d formed in the shoulder 31c of the frame 31 as shown by the arrow e. The inner space of the case 50 is formed at the outer side of the annular 25 space inside the baffle 31f and is not communicated with the back chamber 43b. Namely, the back chambers 43a and 43b are not communicated with each other so that the air in one of the chambers is prevented from entering the other chamber

through the space in the case 50.

In the conventional compound sound generator, the back chamber 22b is communicated with the inner space of the case so that the virtual volume of the chamber is large. Although 5 in the present invention, the virtual volume of the back chamber 43b is much smaller, sufficient acoustic characteristics is maintained. Meanwhile, the advantage that the back chambers 43a and 43b are effectively separated is obtained.

10 Thus, in the present invention, the sounds from the speaker are emitted only from the sound discharge holes 50a and the sounds from the receiver are emitted only from the sound discharge hole 50b. Hence the problems of injury to the ear and leaking of conversation do not occur.

15 The present invention is not limited to the embodiment described above. For example, the outer circumference of the baffle 31f may be larger than that of the first diaphragm 36. The annular space between the baffle 31f and the protector 42 may be communicated with atmosphere through an exclusively 20 formed sound discharge hole, so that the acoustic impedance of the vibration of the diaphragm 41 is reduced, thereby improving the acoustic characteristics. The exclusive sound discharge hole is preferably formed at a position away from the sound discharge hole 50b of the receiver or formed in 25 another wall such as the side wall of the case.

Alternatively, the back chamber of the speaker may be communicated with the atmosphere. Various modifications of structure f thebaffle and air passage and acoustic separating

method and the material thereof are further p ssible.

The present invention provides a compound sound generator where the back chambers of each of the speaker and the receiver are effectively separated from each other by  
5 a simple and inexpensive means of providing a baffle. Accordingly, injury to the ear and leaking of conversation are prevented.

In addition, by communicating the back chamber of the receiver with the annular space surrounding the chamber,  
10 and/or by communicating the back chamber of the speaker with the inner space of the case outside the annular space, the volume of the back chamber of the receiver can be virtually increased so that the acoustic characteristics are not impaired. Moreover, when one of the back chambers is  
15 communicated with atmosphere, the volume thereof can further be increased, thereby reducing the acoustic impedance and hence improving the acoustic characteristics.

While the invention has been described in conjunction with preferred specific embodiment thereof, it will be  
20 understood that this description is intended to illustrate and not limit the scope of the invention, which is defined by the following claims.